SNOOPY:
Student Nanoexperiments for Outreach and Observational Planetary InquirY

Technical Team

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Student Investigators

Angle of Repose of Martian Dust

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Contradistinctive Copper

Kelly Trowbridge & Jessica Sherman
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Spacesuit Materials for Mars

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&

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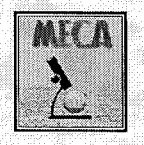



The Motivation

- **Involvement of students worldwide in a planetary science mission.**
  - Stimulate students 18 years of age and younger to explore what is necessary to invent and propose an instrument for space flight.
  - Development of curricula to simulate the nanoexperiments using common materials and "kitchen chemistry."
  - Immediate distribution of returned scientific data to the public for use in classrooms, etc. already prepared to understand it.
- **Prototype of small, self-contained experiments for future missions.**
  - Future competitions can be held for grade schools, undergraduate and graduate students.
  - Tiny "gas-can" type experiments may be proposed by the scientific community at large.

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The Mars Environmental Compatibility Assessment (MECA) Nanoexperiment Challenge

- The MECA Student Nanoexperiments were the first student experiments proposed to go to Mars.
- Conducted in partnership with The Planetary Society, the world-wide competition was open to pre-college students, up to 18 years of age, in teams of 1-3.
- Flight hardware was fabricated by Visionary Products Incorporated, and integrated into the MECA Patch Plate at JPL.

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MECA Nanoexperiment Challenge: Requirements

- Each proposed nanoexperiments was to:
  - Be consistent with MECA's Mission: *"To help us better understand how humans will be able to live on Mars."*
  - Plug directly into the MECA Patch Plate.
  - Fit into a 1 cm diameter tube, 1 cm in height.
  - Have mass less than 3 grams.
  - Be fabricated from space-compatible materials.
  - Be observed only by the Robot Arm Camera.
  - Require no power or communications.
  - Contain no moving parts.
  - Submit prototype and short proposal.

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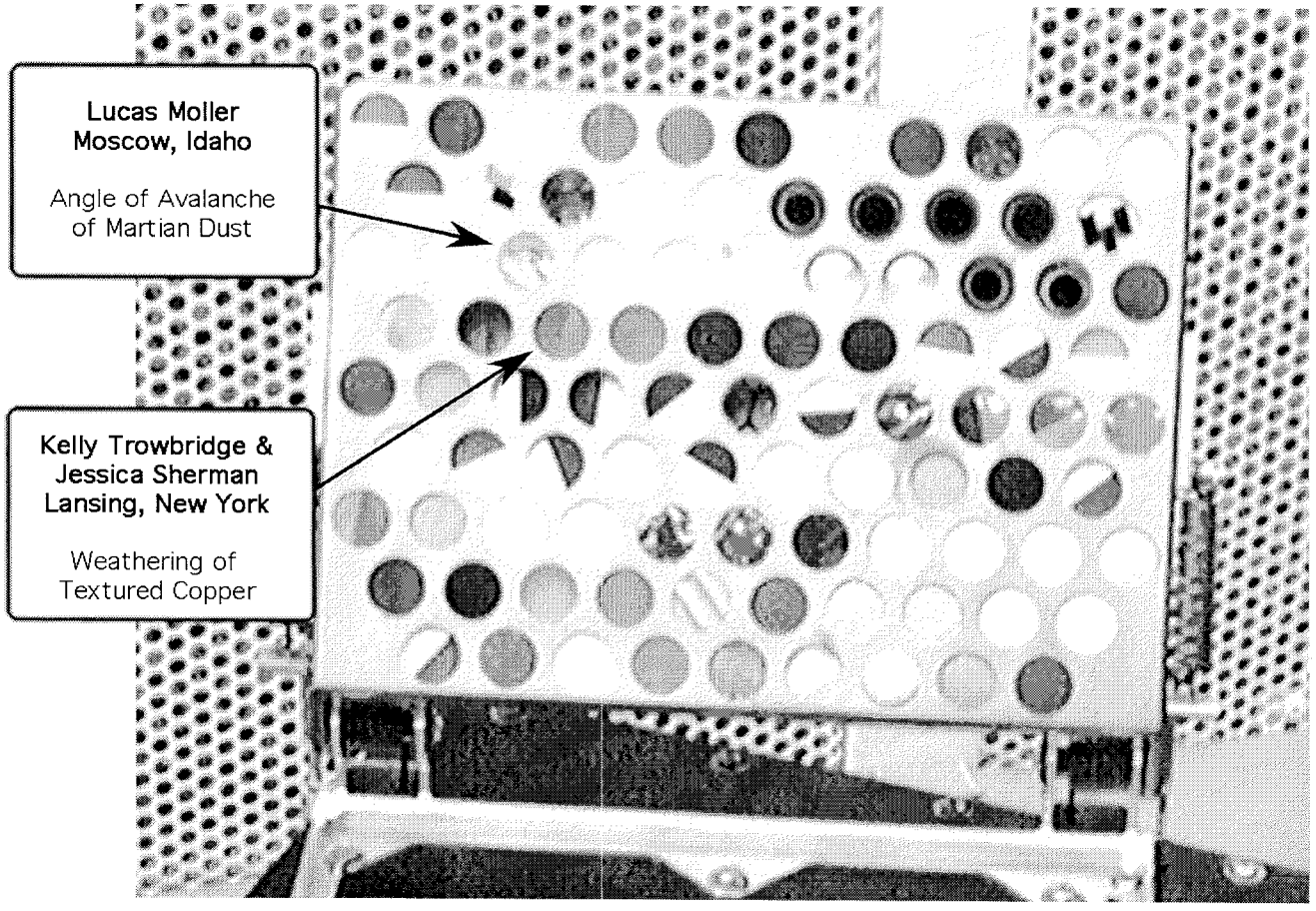
The MECA Patch Plate



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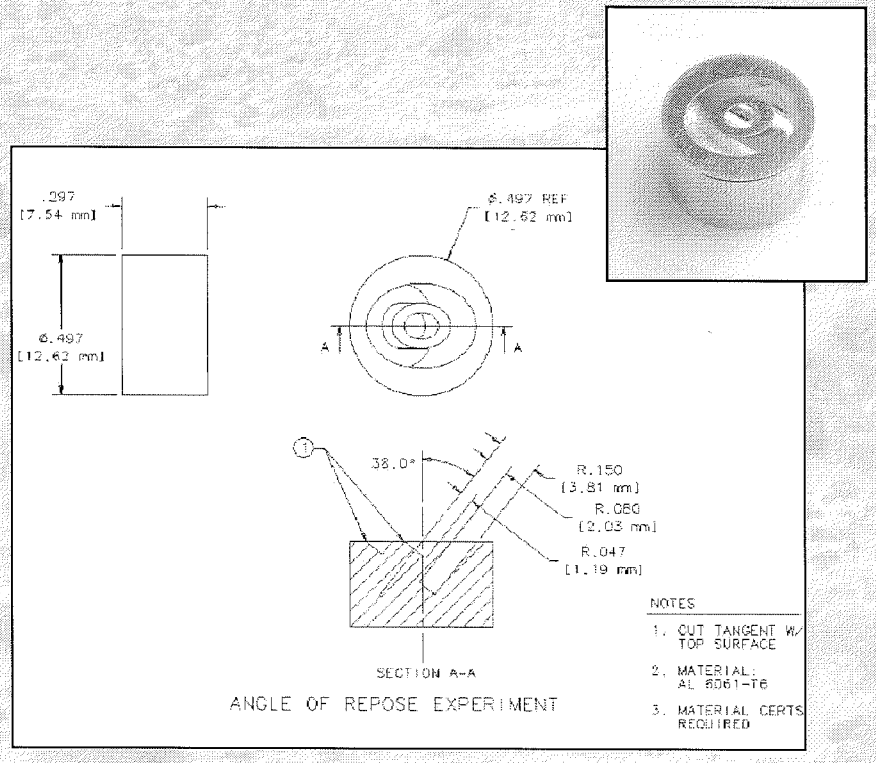
Angle of Avalanche for Martian Dust

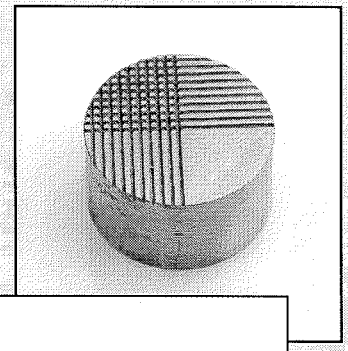
Lucas Möller
5th Grade, Moscow, Idaho.

- **Addressed angle of repose questions posed at Mars 2001 Workshop.**
- **Critical slope necessary for motion of the dust on a surface. (Angle of repose or static friction angle.)**
- **Will print out copies of images and measure the tangent angles with a protractor.**
- **Will compare these angles with results using sand,cement powder and other simulants.**



Contradistinctive Copper

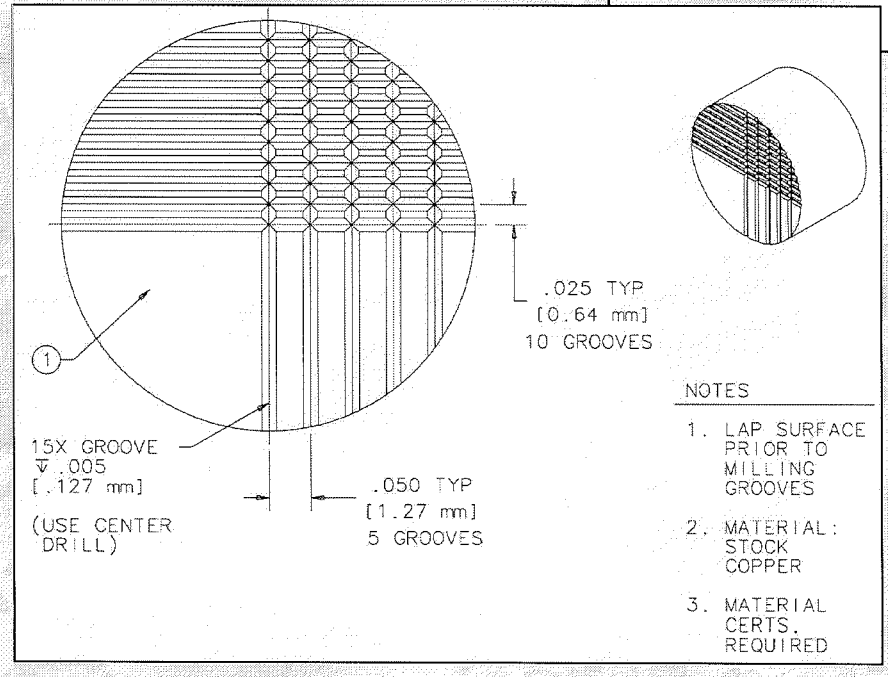
Kelly Trowbridge & Jessica Sherman,
8th Grade, Lansing, New York.



Investigating:

- **Corrosion properties.**
- **Oxidation properties.**
- **Temperature sensitivity.**
- **Dust deposition on different textures = different rates of corrosion and oxidation.**

Advisor: Anna Waldron, Cornell University Science Education Program.



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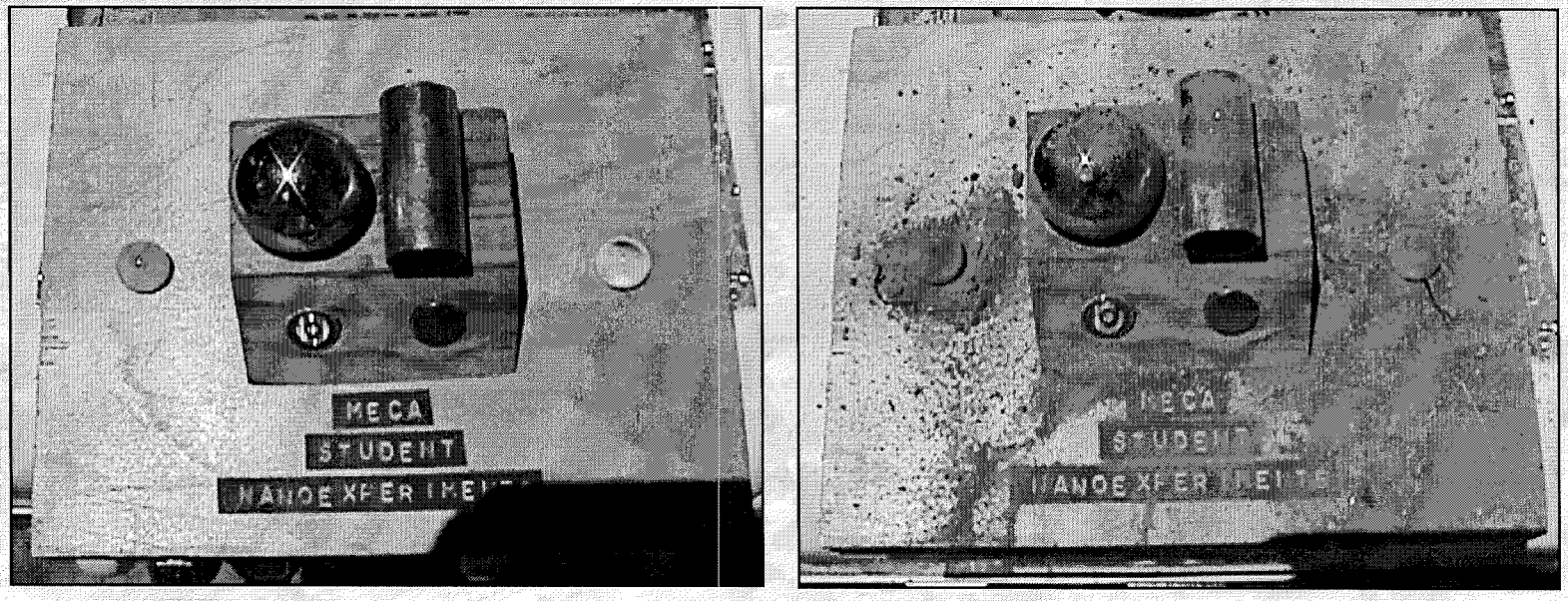
Student Nanoexperiments for Outreach and Observational Planetary Inquiry (SNOOPY)



Old and New Student Nanoexperiment designs tested during NASA Field Integrated Design & Operations (FIDO) testing in the Mojave Desert.

Breadboard and images courtesy of Mike Hecht

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SNOOPY: Redesign of Nanoexperiments for consideration by other Mars Landers

Angle of Repose:

- Eliminates dependence on landing angle.
- Incorporates two materials, one insulating (Macor or alumnia) and one conducting (aluminum) to see if accumulated charge has an effect on the angle of repose.
- Allows for easier viewing using a camera.

Contradistinctive Copper:

- Eliminates dependence on landing angle.
- Provides range of textures through a spectrum of lighting conditions.
- Provides an *in situ* reference coated with Indium Tin Oxide.

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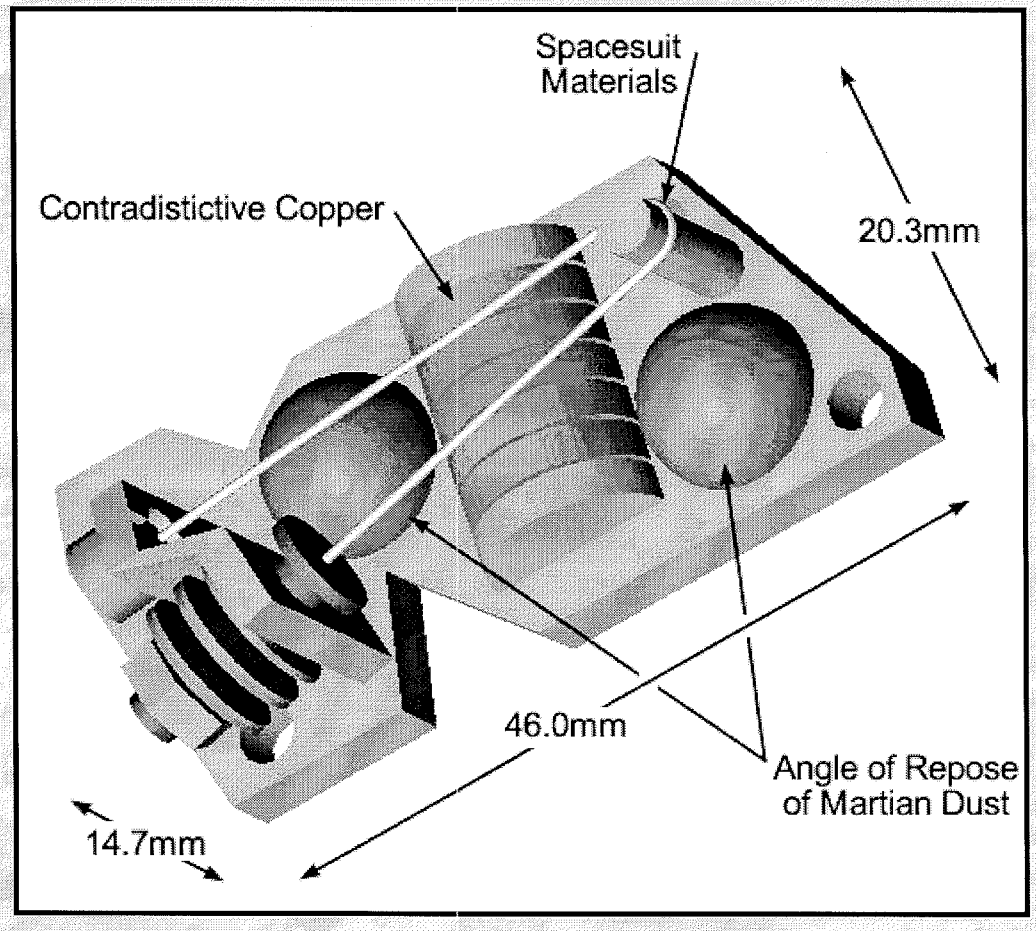
First Generation SNOOPY Payload



SNOOPY Design: Spacesuit Materials

- Alternate nanoexperiment: combination of two proposed nanoexperiments.
- Added since MECA. Although this was a finalist, there was not enough time to prepare this nanoexperiment to fly on MECA in 2001.
- Kevlar fiber will be held under tension and exposed to the Martian environment.
- Wear can be examined with the Beagle 2 stereo camera and possibly with the Beagle 2 microscope.
- Failure of the Kevlar fiber will be easily seen by the Beagle 2 stereo camera. Creep of the Kevlar fiber will also be observed.

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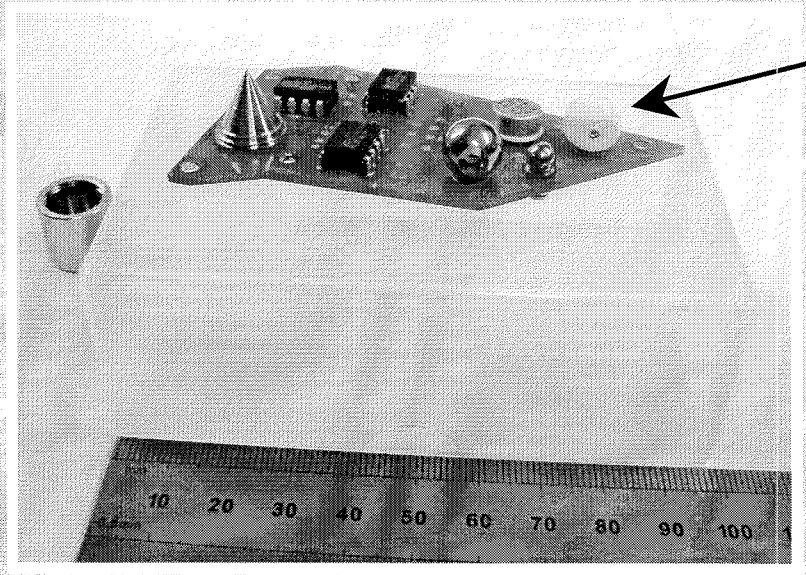
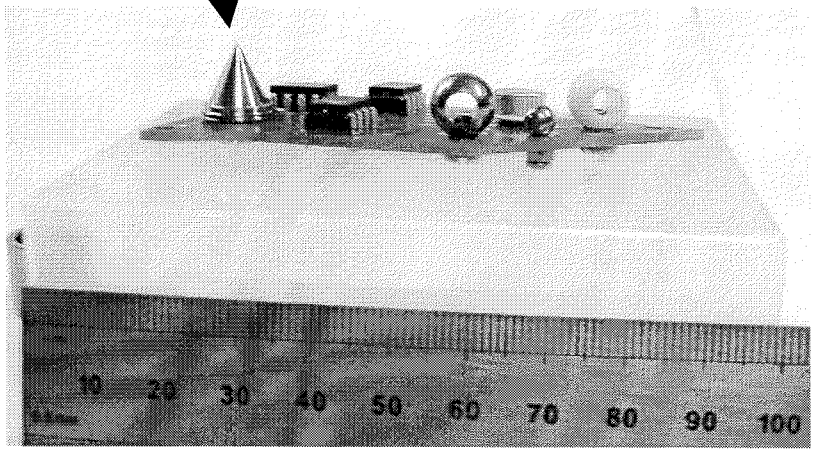
Second Generation SNOOPY: Environmental Sensors Suite (ESS)



- **Angle of Repose**
- **Contradistinctive Copper**



Photographs courtesy of Martin Towner and Mark Sims of the Beagle 2 Enironmental Sensors Suite team.

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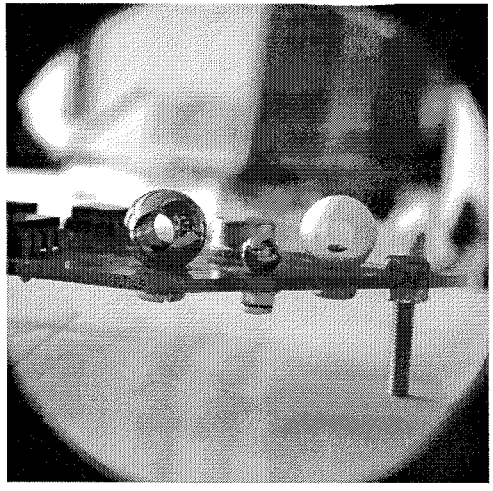
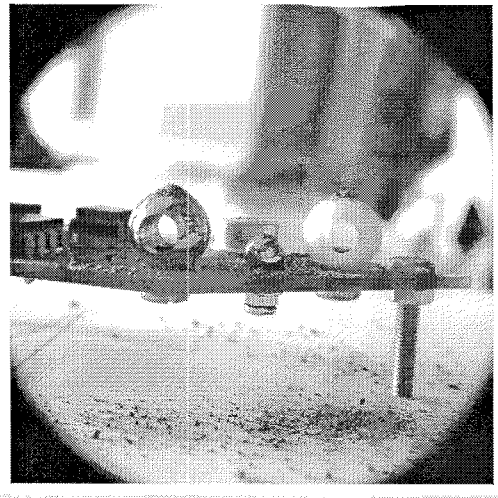
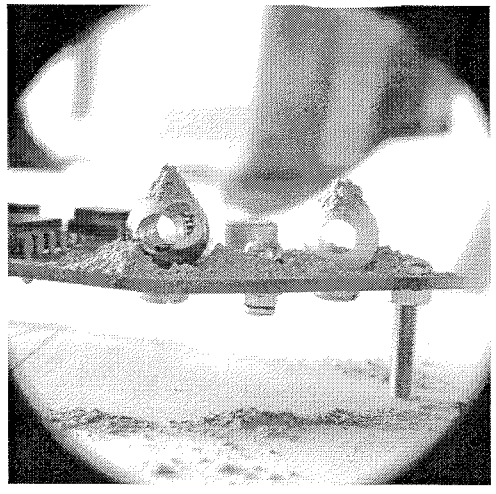
Preliminary Tests of the Environmental Sensor Suite Nanoexperiments



Side view of the Angle of Repose nanoexperiment before testing.



After unsieved Mars JSC-1 simulant has been poured on the nanoexperiment.



After unsieved flintag (similar to JSC Lunar simulant) has been poured on the nanoexperiment.

Photographs courtesy of Martin Towner and Mark Sims of the Beagle 2 Environmental Sensor Suite team.

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Planned Outreach Activities

Student Nanoexperimenters

- Will provide science support of SNOOPY by calibrating their experiments.
- Will publish their results in the scientific literature and present them at the Lunar and Planetary Science Conference.
- Will analyze the data returned from Mars.

Students Worldwide

- Curricular Materials for students to duplicate SNOOPY Nanoexperiments using common materials and equipment.
- Access to data from Mars and analysis by Nanoexperimenters via the World Wide Web.
- Will be able to directly compare the results of their work with the results from Mars.

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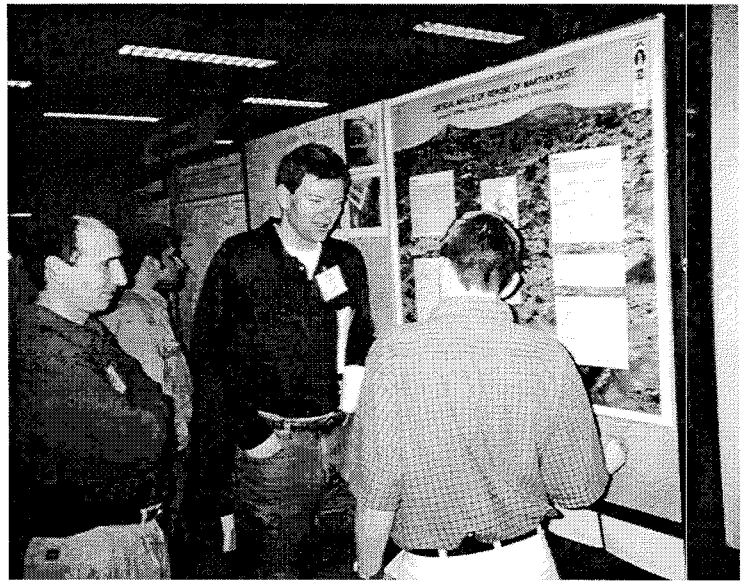
Lucas Möller at 2001 LPSC



Special thanks to the Idaho Space Grant Consortium for sponsoring Lucas' trip to the 2001 and 2002 Lunar and Planetary Science Conferences.

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Jessica Sherman and Kelly Trowbridge working with Bill Nye

Special thanks to the Cornell Nanobiotechnology Center for sponsoring Jessica's and Kelly's laboratory calibration of their Contradistinctive Copper nanoexperiment and their trip to the 2002 LPSC. Thanks also to The Planetary Society for partial support of these trips.

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Future Plans

- Working with students to complete their calibrations and publish their results as well as the results from Mars.
- Design of interactive and collaborative Web site for:
  - •Curricular materials for teachers and students to create their own versions of the Nanoexperiments and perform analyses based on local materials and conditions.
  - •Curricular materials about the process of designing instruments for planetary exploration.
  - •Chat rooms and forums for teachers and students to discuss their results with others around the world.
  - •Announcement of data returned from Mars.
  - •Student Nanoexperimenters' results.

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